release notes

HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0

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HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0

About this document

This document summarizes the most recent product information for HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0 systems:

- Release notes information
- Intended audience
- Accessing future product updates
- Other documentation

📝 **NOTE:**

Support for the HSG family of arrays ended with Secure Path for HP-UX 3.0F. Any references to support for those arrays only applies to 3.0F and earlier releases.

Release notes information

This document describes the following:

- Secure Path 3.0F SP2 kit contents
- Secure Path 3.0F SP2 for Active-Passive disk arrays
  - Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Passive disk arrays
  - Operating system support
  - Avoiding problem situations
  - Event Monitoring Service
  - Determining the active or standby path's hardware path
  - Secure Path driver for Active-Passive disk arrays
  - Secure Path Manager (spmgr)
  - Interoperability with Ignite-UX software
- Secure Path 3.0F SP2 for Active-Active disk arrays
  - Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Active disk arrays
  - Operating system support
  - Avoiding problem situations
- Secure Path device path representation and usage
  - Device path representation of Secure Path for Active-Active disk arrays
  - Differences between Secure Path for Active-Active disk arrays and LVM PVLINKS
  - HP recommendations

Intended audience

This document is intended for customers who have purchased the HP StorageWorks Secure Path 3.0F SP2 for HP-UX 11i v1.0 and 11i v2.0 on Active-Passive and Active-Active disk arrays. The document is also intended for customers who are responsible for installing, configuring, and maintaining this product in their HP-UX server environment.

Accessing future product updates

HP recommends that customers sign up online using the Subscriber's choice web site:
http://www.hp.com/go/e-updates.

- Subscribing to this service provides you with e-mail updates on product enhancements, newer versions of drivers, and firmware documentation updates, as well as instant access to other product resources.
- After signing up, you can quickly locate your products by selecting **Business support** and then **Storage** under Product Category.

Other documentation

Additional documentation that you may find helpful includes:

- *HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0 installation and reference guide* (part number AA–RR4VK–TE).
- White papers and best-practices documents are available at http://www.hp.com/country/us/ eng/prodserv/storage.html.

Secure Path 3.0F SP2 kit contents

The Secure Path 3.0F SP2 for HP-UX kit includes:

- Secure Path 3.0F Service Pack 2 for HP-UX readme.txt document
- *HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0 installation and reference guide* (part number AA-RR4VK-TE)
- Secure Path 3.0F SP2 for HP-UX 11i v1.0 and HP-UX 11i v2.0 CD-ROM

The Secure Path 3.0F SP2 for HP-UX 11i v1.0 and 11i v2.0 web kit includes:

- Secure Path 3.0F Service Pack 2 for HP-UX readme.txt document
- HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0, 2.0 compressed tar package, which includes the software and the release notes

> **NOTE:**
> For Secure Path 3.0F SP2, the `swlist` command displays the version as A.3.0F.02F.00F.
>
> Secure Path 3.0F SP2 release notes supersede all earlier versions of the release notes. See the Secure Path 3.0F SP2 kit documentation for Secure Path operating details.

Secure Path 3.0F SP2 for Active-Passive disk arrays

This section describes the following:

- Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Passive disk arrays
- Operating system support
- Avoiding problem situations
- Event Monitoring Service
- Determining the active or standby path's hardware path
- Secure Path driver for Active-Passive disk arrays
- Secure Path Manager (spmgr)
- Interoperability with Ignite-UX software

Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Passive disk arrays

The following issues have been resolved in Secure Path 3.0F SP2 for Active-Passive disk arrays:

- In Secure Path 3.0F SP1, the `spmgr add` command failed while adding a LUN or a device after the LUN was deleted using the `spmgr delete` command, and the system was rebooted.
- Attempting to run multiple `spmgr` commands would fail after displaying the following error message:

  `Error:  Handshake failed.  Please retry again.`
- Patch updates on HP-UX 11i v1.0 and HP-UX 11i v2.0 resulted in system panic due to the changed loading order of the Secure Path driver(s) `hsx`, `swsp`, and `swspBus` during kernel rebuild.
- Installing Secure Path 3.0F or later on N-class servers (RP74xx) running HP-UX 11i v2.0 resulted in:
  - System panic, if the disk on the SCSI slot `0/0/0.2` was a boot disk
  - Disappearance of the disk on the SCSI slot `0/0/0.2` if it was a data disk
- The array sometimes returned 0 (zero) as the LUN WWN if the controller was not ready to receive SCSI commands for the LUNs. In the previous releases, Secure Path marked the LUNs as dead.

Operating system support

Table 1 lists the system features and requirements for Secure Path 3.0F SP2 for Active-Passive disk arrays. For additional support information, go to the HP web site http://www.hp.com/support.

Table 1 Secure Path 3.0F SP2 for Active-Passive disk arrays system features and requirements

System feature	Requirement
HP-UX version	HP-UX 11i (v1.0, v2.0) 64-bit HP-UX 11i (v1.0) 32-bit
HP-UX server system types	A-class: rp24xx K-class (64-bit only): Kx60, Kx70, Kx80 L-class: rp54xx N-class: N4000, rp74xx V-class: V2200, V2250, V2500, V2600 rp3440, rp4440, rp7410, rp7420, rp8400 rx1600, rx2600, rx4640, rx5670, rx7650, rx8620 zx2000, zx6000 Superdome, Superdome Integrity
File systems	HFS (UFS) JFS (VxFS)
Controllers	Dual HSV100 controllers running VCS 3.010 or later Dual HSV110 controllers running VCS 3.010 or later
SCSI modes	SCSI-2 with or without CCL SCSI-3 with CCL
Volume managers	HP Logical Volume Manager (LVM) or Veritas Volume Manager (VxVM)
Clustering	HP MC/ServiceGuard 11.15 or later
Fibre Channel mode	Switched fabric

> **NOTE:**
> Secure Path 3.0F SP2 supports the Fibre Channel switches and firmware listed in the *HP StorageWorks SAN design reference guide* at http://h18006.www1.hp.com/products/storageworks/san/documentation.html.

Table 2 lists the supported devices and driver requirements for this release and earlier releases of Secure Path for Active-Passive disk arrays.

Table 2 Secure Path 3.0F SP2 for Active-Passive disk arrays supported devices and driver requirements

HP-UX version	Supported HBAs	Driver version (minimum)	Supported storage arrays
11i v1.0	A5158A A6685A A6795A A6826A	Fibre Channel B.11.11.01	EVA3000 (HSV100) EVA5000 (HSV110)
11i v1.0	A6826A A9782A A9784A AB378A AB379A	Fibre Channel B.11.11.07.01	EVA3000 (HSV100) EVA5000 (HSV110)
11i v2.0	A6795A A6826A A9782A A9784A AB378A AB379A	Fibre Channel B.11.23.04.01	EVA3000 (HSV100) EVA5000 (HSV110)

Table 3 lists the patch revisions for this release of Secure Path for Active-Passive disk arrays.

Table 3 Patch revisions for Secure Path 3.0F SP2 for Active-Passive disk arrays

HP-UX version	Patch revisions (minimum)
11i v1.0	HWEnable11iB.11.11.0505 or later PHKL_33367: (u)mount performance PHKL_27321: Early KRS PHKL_27096 PHKL_34478: WSIO Patch PHKL_33372: VM Patch PHKL_34161: Fibre Channel Mass Storage Patch PHKL_34106: Dump Patch1 for EVA support PHKL_34187: SCSI IO Cumulative Patch PHKL_34024: getmount_entry PHKL_30607: Dump Patch2 for EVA support PHKL_34518: LVM cumulative Patch PHKL_33484 (VxFS cumulative) PHKL_34665 PHKL_32089 PHCO_27957: umount(1M) cumulative PHCO_33205: mountall cumulative PHCO_27959: umountall(1M) cumulative PHCO_30730: VxVM Enterprise Administrator Srvc patch PHCO_30731: VxVM Enterprise Administrator Patch PHCO_33327: mount(1M) cumulative PHCO_33711: libc cumulative patch PHCO_34196 PHCO_31923
11i v2.0	N/A

Table 4 lists the configuration limits for Secure Path 3.0F SP2 for Active-Passive disk arrays.

Table 4 Configuration limits for Secure Path 3.0F SP2 for Active-Passive disk arrays

Parameter	Minimum	Maximum qualified	Maximum supported
Adapter support	1	8	Platform limit
Storage arrays per host	1	8	128
LUNs per storage array per host	1	256	Array limit

Avoiding problem situations

The section describes problems that may arise during Secure Path operation and how to avoid them:

- General problems
- Problem with setboot command
- Reconfiguring dump devices in the event of path failover
- Installing Secure Path in a Virtual Partitions environment
- LUN collision

IMPORTANT:

For information about Secure Path device path representation and usage, see "Secure Path device path representation and usage".

General problems

This section describes problems that may arise during Secure Path operation and how to avoid them.

- When Secure Path is installed on HP-UX 11i v2.0, the following warning messages are displayed, which you can ignore:

```
ld:  (Warning) Ignoring .IA_64.unwind_hdr section in file
"/usr/conf/mod/hsx".
ld:  (Warning) Ignoring .IA_64.unwind_hdr section in file
"/usr/conf/mod/swsp".
ld:  (Warning) Ignoring .IA_64.unwind_hdr section in file
"/usr/conf/mod/swspBus" .   3 warnings.
```

- After adding new LUNs and executing `ioscan`, a syslog message indicates that the `ioscan` operation aborted. If the newly added LUNs are owned by `sdisk` instead of `hsx` (Secure Path), run `rmsf - H h/w_addr` for that `sdisk` entry, and then run `ioscan` to enable ownership of the LUNs by Secure Path.

- Concurrent or overlapping `ioscans` can result in the first `ioscan` reporting the intermediate path states of the second `ioscan` while the second `ioscan` correctly reports the state of the paths. An application that performs `ioscan` comparisons could erroneously detect an error when overlapped by another `ioscan`.

- During an `ioscan`, `sdisk` drivers attach to `swsp` interface drivers instead of to the `fcparray` (SCSI-3) or `fcpdev` (SCSI-2). Be careful with applications that use `ioscan` outputs that depend on the hardware tree, which existed prior to Secure Path installation.

- When a path to a device managed by LVM becomes unavailable because of a controller, path link, switch, or HBA failure, I/O requests can be delayed by up to one minute immediately after the failure. As a result, the responsiveness of mirrored logical volumes may affected briefly.

  When a physical volume becomes unavailable, applications normally experience a delay while an I/O request to that physical volume times out. By default, this delay lasts 30 seconds, (although you can change the duration of the delay by using the `pvchange (1M)` command).

  - In the case of a read operation, LVM selects another mirror and tries again.
  - In the case of a write operation, LVM records the error and continues as long as the data has been successfully written to at least one mirror.

  In either case, with Secure Path installed, this initial timeout can last up to one minute. After the timeout, LVM keeps track of the physical volume status as Unavailable, and future I/O request do not suffer the delay.

- Do not make any SAN configuration changes to the system during the upgrade or installation of Secure Path 3.0F SP2. For example, do not add new arrays or LUNs, or delete arrays or LUNs during upgrade or installation of Secure Path 3.0F SP2.

- Due to constraints imposed by the software distributor (SD) tools, the server's network must be configured before installation of Secure Path.

- Stopping `spagent` using the `spinit stop` command, and then starting `spagent` using the `spinit start` command results in `stderr` messages. To prevent these messages from printing, start `spagent` in a new session and then exit that session.

- Do not use the HP System Administration Manager (SAM) to create or extend volume groups. Creating and extending volume groups must be done using HP-UX commands. When SAM scans for hardware, any HSV1xx LUNs created after the first LUN are not parsed correctly by SAM and cannot be selected to create a volume group. Use HP-UX commands to create or extend volume groups, and then use SAM to create and manage logical volumes.

- Ensure that the port speeds for 2 GB or 4 GB Fibre Channel switches have been set correctly and that they are not set to auto-negotiate.
- When creating snapshots or clones of a device that is managed by LVM, be sure to configure LVM properly. After creating a snapshot or clone of a physical volume, always run `vgchgid(1M)` to break the association between the volume group and the snapshot or clone. Otherwise, LVM assumes that the snapshot or clone is an alternate path to the original physical volume. This could lead to data corruption if the snapshot or clone was added later to the volume group using `vgextend(1M)`, `vgimport(1M)`, or `vgscan(1M)`.
- When replacing array controllers online, enable path verification to update controller IDs in Secure Path data structures. If path verification is not enabled during controller replacement, use the `spmgr refreshdisplay` command to update the serial numbers of the controller.

Problem with setboot command

The `setboot` command fails to set the alternate or high-availability hardware path on the HP-UX 11i v2.0 IA-64 platform for SAN boot disks on EVA Active-Passive disk arrays.

Follow the steps below to set the primary, alternate, and high-availability hardware paths from the EFI shell, which requires a system reboot:

1. If Secure Path is not installed on your system, run `ioscan -fneC disk` and record the EFI path and hardware path for each bootable device. If Secure Path is installed on your system, see "Determining the active or standby path's hardware path".

```
Class I H/W Path Driver S/W State H/W Type Description
================================================================
disk 2 0/0/2/1.3.0 sdisk CLAIMED DEVICE HP DVD-ROM 305
/dev/dsk/c1t3d0 /dev/rdsk/c1t3d0
Acpi(HWP0002,0)/Pci(2|1)/Scsi(Pun3,Lun0)/\EFI\HPUX\HPUX.EFI disk 0
0/1/1/0/1/1.0.0 sdisk CLAIMED DEVICE HP 36.4GST336753LC
/dev/dsk/c3t0d0 /dev/dsk/c3t0d0s2 /dev/rdsk/c3t0d0 /dev/rdsk/
c3t0d0s2
/dev/dsk/c3t0d0s1 /dev/dsk/c3t0d0s3 /dev/rdsk/c3t0d0s1
/dev/rdsk/c3t0d0s3
Acpi(HWP0002,0)/Pci(2|1)/Scsi(Pun3,Lun0)/\EFI\HPUX\HPUX.EFI disk 0
0/1/1/0/1/1.0.0 sdisk CLAIMED DEVICE HP 36.4GST336753LC
Acpi(HWP0002,100)/Pci(1|0)/Pci(1|1)/Scsi(Pun0,Lun0)/
HD(Part1,SigC44D04A0-0672-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI
disk 6 0/2/1/0.16.1.0.0.0.3 sdisk CLAIMED DEVICE COMPAQ HSV110
(C)COMPAQ
Acpi(HWP0002,200)/Pci(1|0)/Fibre(WWN5002B36C,Lun0)/
HD(Part1,SigC8FB3EDE-79D3-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI
disk 14 0/2/1/0.16.4.0.0.0.3 sdisk CLAIMED DEVICE COMPAQ HSV110
(C)COMPAQ
Acpi(HWP0002,200)/Pci(1|0)/Fibre(WWN5002B36D,Lun0)/
HD(Part1,SigC8FB3EDE-79D3-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI
disk 17 0/5/1/0.16.1.0.0.0.3 sdisk CLAIMED DEVICE COMPAQ HSV110
(C)COMPAQ
Acpi(HWP0002,500)/Pci(1|0)/Fibre(WWN5002B36C,Lun0)/
HD(Part1,SigC8FB3EDE-79D3-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI
disk 26 0/5/1/0.16.4.0.0.0.3 sdisk CLAIMED DEVICE COMPAQ HSV110
(C)COMPAQ
Acpi(HWP0002,500)/Pci(1|0)/Fibre(WWN5002B36D,Lun0)/
HD(Part1,SigC8FB3EDE-79D3-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI
```

2. During the system boot, you must use the EFI Boot Manager to interrupt the process:

```
EFI Boot Manager ver 1.10 [14.60] Firmware ver 2.21 [4306]
```

```
Please select a boot option
HP-UX Primary Boot:  0/5/1/0.16.4.0.0.0.3
HP-UX HA Alternate Boot:  0/1/1/0/1/1.0.0
HP-UX Alternate Boot:  0/1/1/0/1/1.2.0
EFI Shell [Built-in]
Boot option maintenance menu
Security/Password Menu
Use ^ and v to change option(s).  Use Enter to select an option
```

3. Select **Boot option maintenance menu**:

```
Boot from a File
Add a Boot Option
Delete Boot Option(s)
Change Boot Order
Manage BootNext setting
Set Auto Boot TimeOut
Select Active Console Output Devices
Select Active Console Input Devices
Select Active Standard Error Devices
Cold Reset
Exit
```

4. Select **Add a Boot Option**:

```
IA64_EFI [Acpi(HWP0002,200)/Pci(1|0)/Fi-
bre(WWN50001FE15002B36C,Lun4003000000000000)/HD(Part1,SigC8FB3EDE-
79D3-11D9-800
IA64_EFI [Acpi(HWP0002,200)/Pci(1|0)/Fi-
bre(WWN50001FE15002B36C,Lun4003000000000000)/HD(Part3,SigC8FB3F38-
79D3-11D9-800
IA64_EFI [Acpi(HWP0002,200)/Pci(1|0)/Fi-
bre(WWN50001FE15002B36D,Lun4003000000000000)/HD(Part1,SigC8FB3EDE-
79D3-11D9-800
IA64_EFI [Acpi(HWP0002,200)/Pci(1|0)/Fi-
bre(WWN50001FE15002B36D,Lun4003000000000000)/HD(Part3,SigC8FB3F38-
79D3-11D9-800
IA64_EFI [Acpi(HWP0002,100)/Pci(1|0)/Pci(1|1)/Scsi(Pun2,Lun0)/
HD(Part1,Sig8CC0A96A-6072-11D9-800
IA64_EFI [Acpi(HWP0002,100)/Pci(1|0)/Pci(1|1)/Scsi(Pun2,Lun0)/
HD(Part3,Sig8CC0A9BA-6072-11D9-800
Removable Media Boot [Acpi(HWP0002,0)/Pci(2|1)/Scsi(Pun3,Lun0)]
Load File [EFI Shell [Built-in]]
Load File [Acpi(HWP0002,100)/Pci(1|0)/Pci(4|0)/Mac(00306E495F6F)
Exit
```

📝 **NOTE:**

To list the LUNs of other controllers, see "Enumerating all Fibre Channel devices".

To determine the EFI path of a physical hardware path of the device, see "Identifying the EFI path of the physical hardware path with Secure Path".

5. Select any of the Fibre Channel options (as described in step 1). Select the boot partition **Part1**. Example:

```
IA64_EFI
```

```
[Acpi(HWP0002,200)/Pci(1|0)/Fibre(WWN50001FE15002B36D,Lun400300
0000000000)/HD(Part1,SigC8FB3EDE-79D3-11D9-800
02/08/05 08:18a <DIR> 4,096 EFI
[Treat like Removable Media Boot]
Exit
```

6. Select the EFI directory:

```
02/08/05 08:18a <DIR> 4,096 .
02/08/05 08:18a <DIR> 0 ..
02/08/05 08:18a <DIR> 4,096 HPUX
02/08/05 08:18a <DIR> 4,096 Intel_Firmware
02/08/05 08:18a <DIR> 4,096 DIAG
02/08/05 08:18a <DIR> 4,096 HP
02/08/05 08:18a <DIR> 4,096 TOOLS
Exit
```

7. Select the HP-UX directory:

```
02/08/05 08:18a <DIR> 4,096 .
02/08/05 08:18a <DIR> 4,096 .  .
02/08/05 08:33a <DIR> 521,494 HPUX.EFI
02/08/05 08:33a <DIR> 24,576 NBP.EFI
Exit
```

8. Select the `HP-UX.EFI`:

```
Filename:  \EFI\HPUX\HPUX.EFI
DevicePath:  [Acpi(HWP0002,200)/Pci(1|0)/Fi-
bre(WWN50001FE15002B36D,Lun4003000000000000)/HD(Part1,SigC8FB3EDE-
79D3-11D9-8002-D6217B60E588)/\EFI\HPUX\HPUX.EFI]
IA-64 EFI Application 02/08/05 08:33a 521,494 bytes
Enter New Description:
```

> **NOTE:**
> The device already exists in the boot option if the system displays `Edit Existing Boot Option` or `make a new entry [E-Edit N-New]:`. Proceed but do not save the changes to NVRAM; that is, proceed till step 10 and enter **N** when prompted.

9. Enter a description to display in the available boot options in the EFI boot manager; for example:

```
Enter New Description:  0/2/1/0.16.4.0.0.0.3
New BootOption Data.  ASCII/Unicode strings only, with max of 240
characters
Enter BootOption Data Type [A-Ascii U-Unicode N-No BootOption] :
```

10. Enter **N**:

```
Enter BootOption Data Type [A-Ascii U-Unicode N-No BootOption] :
None
```

11. Enter **Y**:

```
Save changes to NVRAM [Y-Yes N-No]:
```

12. Select **Exit** to return to the **Boot option maintenance** menu, as described in . Select **Change Boot Order**.

13. Select the newly added boot option and use the **U** key to move it to the desired position in the boot order.

14. Select **Save changes to NVRAM**.

Identify the EFI path of the physical hardware path on systems that have Secure Path installed.

Determining the active or standby path's hardware path

To determine the hardware path of a standby path by using the `spmgr display` and `ioscan` commands, see *"Installing Secure Path on a SAN boot device"* in the *HP StorageWorks Secure Path 3.0F Service Pack 2 for HP-UX 11i v1.0 and 11i v2.0 installation and reference guide*.

To determine the hardware path of a standby path:

1. Enter the `spmgr display -dv boot device` command on the host. In this example, the boot device is `/dev/dsk/c12t1d2`.

```
spmgr display -dv c12t1d2
```

The following output is displayed:

```
Server:aphn1.india.hp.comReport Created:  Fri, Jan 30 18:44:42 2004
Command:  spmgr display -dvc12t1d2

Device:c12t1d2 Status:Operational[4 paths (1/0/2)] Storage:
5000-1FE1-0015-0AE0 LUNID: 6005-08B4-0001-4920-0001-6000-04EA-0000
Preferred Controller:  None HBAs:td4td6

Item Device Controller HBA H/W_Path Instance

= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

0 c12t1d2 P4889B49IM403L td4 255/255/0/2.3 c4t1d3 WWPN: N/A Path
State:  Active

1 c12t1d2 P4889B49IM403L td6 255/255/0/2.3 c8t1d3 WWPN: N/A Path
State:  Available

2 c12t1d2 P4889B49IM403A td4 255/255/0/2.3 c6t1d3 WWPN: N/A Path
State:  Standby

3 c12t1d2 P4889B49IM403A td6 255/255/0/2.3 c10t1d3 WWPN: N/A Path
State:  Standby
```

The output shows four operation paths: one is in Active path state, one is in Available path state, and two are in Standby path state. Select one of the path instances to determine the hardware path (for example, `c6t1d3`). Note the values `c(6)`, `t(1)`, and `d(3)` in the instance.

2. Enter the `ioscan -kfnC ext_bus` command. Output similar to the following is displayed:

```
# ioscan -kfnC ext_bus

Class I H/W Path Driver S/W State H/W Type Description

= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =

ext_bus 0 0/0/1/0 c720 1 CLAIMED INTERFACE SCSI C896 Ultra Wide
Single-Ended

ext_bus 1 0/0/1/1 c720 CLAIMED INTERFACE SCSI C896 Ultra Wide
Single-Ended

ext_bus 2 0/0/1/1 c720 CLAIMED INTERFACE SCSI C87x Ultra Wide
Single-Ended

ext_bus 3 0/0/1/1 c720 CLAIMED INTERFACE SCSI C87x Ultra Wide
Single-Ended

ext_bus 4 0/3/0/0.1.10.0.0 fcparray CLAIMED INTERFACE FCP Array
Interface

ext_bus 6 0/3/0/0.1.11.0.0 fcparray CLAIMED INTERFACE FCP Array
Interface

ext_bus 12 255/255/0 swsp CLAIMED VIRTBUS HSV110 (C)COMPAQ
0x50001FE1500049B0
```

Use the second (instance) and third (H/W path) fields of the output to determine the hardware path. Find the `ext_bus` device that has the same instance number as the value of c in
. In this example, it is `ext_bus 6`.

```
ext_bus 6 0/3/0/0.1.11.0.0 fcparray CLAIMED INTERFACE FCP Array
Interface
```

3. Append the `t` and `d` values from (step 1 `t(1)`, `d(3)`) to the hardware path determined in step 2 to determine the hardware path of the standby path. In this example, the hardware path for the standby path is `c6t1d3` is `0/3/0/0.1.11.0.0.1.3`.

Identifying the EFI path of the physical hardware path with Secure Path

To identify the EFI path of the physical hardware path with Secure Path:

1. Note the active controller serial number using `spmgr display -dv <HSx boot device>`. In this example, it is `P5849D5AAPN00W`.

```
Server:  aphia3.india.hp.com Report Created:  Fri, Feb 25 18:33:19
2005

Command:  spmgr display -dv c24t0d2

Device:  c24t0d2

Status:  Operational [8 paths (4/0/4)]

Storage:  5000-1FE1-5002-B360

LUNID: 6005-08B4-0001-3680-0001-0000-0083-0000

Preferred Controller:  None

HBAs:  td0 td3

Item Device Controller HBA H/W_Path Instance
= = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = = =
0 c24t0d2 P5849D5AAPN00W td0 255/255/0/0.2 c4t0d3 WWPN: Unknown Path
State:  Active [P]

1 c24t0d2 P5849D5AAPN00W td0 255/255/0/0.2 c10t0d3 WWPN: Unknown
Path State:  Active

2 c24t0d2 P5849D5AAPU05E td0 255/255/0/0.2 c6t0d3 WWPN: Unknown Path
State:  Standby

3 c24t0d2 P5849D5AAPU05E td0 255/255/0/0.2 c8t0d3 WWPN: Unknown Path
State:  Standby
```

2. Note the port WWNs of the active controller using Command View EVA. For this controller `P5849D5AAPN00W`, the port WWNs are `50001FE15002B36C` and `50001FE15002B36D`.

Enumerating all Fibre Channel devices

To enumerate all Fibre Channel devices, select **EFI Shell [Built-in]** from the EFI Boot Manager, as described in step 2 of "Problem with setboot command".

```
Shell> drivers

V VERSION E G G #D #C DRIVER NAME IMAGE NAME
== ======== = = = == == ================================
14 00000010 B - - 8 17 PCI Bus Driver PciBus
25 00000110 B X X 1 6 HP Tachyon XL2 Fibre Channel Mass S PciRom
Seg=00000000
27 00000140 D X X 1 - HP 2 Gb Fibre Channel Driver PciRom
Seg=00000000
28 00000140 D X X 1 - HP 2 Gb Fibre Channel Driver PciRom
Seg=00000000
2B 00000110 B X X 1 6 HP Tachyon XL2 Fibre Channel Mass S PciRom
Seg=00000000
Choose the fibre channel drivers of the system
Shell> drvcfg 25
Configurable Components Drv[25] Ctrl[26] Lang[eng]
Shell> drvcfg -s 25 26
Current policy: Enumerate all Fibre Channel devices
Please select the desired enumeration policy:
0 : Enumerate all Fibre Channel boot devices in the boot option
list
1 : Enumerate all Fibre Channel devices
```

```
Q : exit with no change
Policy >
Choose 1.
Repeat the steps for the other driver instance too (in this example 2B)
Shell> reconnect -r

Shell> exit
```

Reconfiguring dump devices in the event of path failover

In the event of a path failover to a device configured as a system dump device, a reconfiguration using an alternate active path to the device is attempted automatically.

> **NOTE:**
>
> This section applies only to HP-UX 11i v1.0. Reconfiguration of dump devices in the event of a path failover is automatic in later versions of HP-UX.

Under certain circumstances, dump reconfiguration using the new path may fail (for example, dump configuration through `crashconf(1M)` occurring in parallel to a path failover event and the event timing out).

If this occurs, an error message is logged in `/var/adm/syslog/syslog.log`, indicating the device name for the failed automatic path reconfiguration.

To correct this situation:

1. Note the `ctd/volume` name of the device for which configuration has failed (based on information in the error message).
2. Ensure that this device is a dump device using the `crashconf(1M)` command.
3. Reconfigure this device as a dump device using the `crashconf(1M)` command.

Installing Secure Path in a Virtual Partitions environment

To install Secure Path in a Virtual Partitions (vPars) environment on an EVA boot LUN, complete the steps below:

1. Install the HP-UX operating system on an EVA LUN.
2. Install the following kernel patch:

   `PHKL_33581`(s700_800 11.23 USB DVD Boot, EFI Device Path, HW Enablement)
3. Install the HP-UX vPars software A.04.02.01 or later.
4. Use the `vparcreate` command to create virtual partitions, and then boot each partition.

   > **NOTE:**
   >
   > You must install the patch PHKL_33581 on each partition.

5. Install Secure Path 3.0F SP2 on each partition.

> **NOTE:**
>
> If you installed Secure Path on an EVA boot LUN, you cannot install vPars on that LUN. See *Installing and Managing HP-UX Virtual Partitions* for more information on vPars.

LUN collision

If path verification is disabled and a device is unpresented before deleting it with the `spmgr delete` command, and a new device is added with the same virtual disk or unit number as the old device, the new device is bound to the `WWLUNID` of the old deleted device. This leaves the new device in an Inconsistent state. Do not perform any operations until you perform the following recovery procedure:

1. Ensure that the old LUN is not in use (for example, suspend I/O).
2. Put the LUN in the Inactive state:
   • If the LUN is mounted, unmount it.
   • If the LUN is part of an LVM volume group, deactivate it.
3. When the LUN is in the Inactive state, enter the following commands:
   ```
   spmgr delete old_device
   ioscan
   insf -e
   ```
4. Use the `spmgr display` command to confirm that the new LUN is discovered.

NOTE:

To prevent the LUN from being left in the Inconsistent state, delete the device by using the `spmgr delete` command before unpresenting the device.

If path verification is enabled, the LUN collision is identified and an appropriate message is logged in the syslog. Follow the instructions in the syslog to resolve this problem.

Event Monitoring Service

This section describes the Secure Path's Event Monitoring Service (EMS):

• High-availability EVA environment recommendations
• EVA

High-availability EVA environment recommendations

In high-availability environments with heavy I/O loads, you may experience I/O timeout conditions. If I/O timeouts occur, HP recommends that you use the `pvchange` command to increase the `IO_timeout` value from a default of 30 seconds to a maximum of 60 seconds for LUNs (virtual disks) on EVA 2.0 or EVA 3.0. Under heavy I/O load conditions, the increased `IO_timeout` value allows for longer I/O completion times and for LUN access delays if a controller failover occurs.

NOTE:

Make sure that HP MC/ServiceGuard is configured properly. See the HP MC/ServiceGuard documentation for configuration information or go to the HP web site http://docs.hp.com.

EVA

Disable EMS for all devices or LUNs on an EVA storage system.

Secure Path driver for Active-Passive disk arrays

The following problems may arise with Secure Path driver for Active-Passive disk arrays:

- On a server reboot, the active path comes up on the last path probed and not necessarily on the preferred path, regardless of the status of auto-restore or whether a preferred path has been selected. To restore the active paths to their preferred paths, use the `spmgr restore all` command.

- After a LUN has been deleted using the `spmgr delete` command, and is unpresented at the array, any re-presenting of that device and an `ioscan` results in the device being displayed in the `spmgr display -u` unattached list. The Secure Path driver keeps track of the deleted status of the device `WWLUNID`.

- Do not make any SAN configuration changes to the system when upgrading or installing Secure Path. For example, do not add new LUNs or delete arrays or LUNs.

- When the system is booting, do not execute Secure Path commands until the Secure Path startup services have started.

- If you configure Secure Path devices under volume groups and reboot the system, the volume groups are not activated as part of the system's volume group configuration during boot time. This occurs because the Secure Path persistence module is loaded (at `init level 1`) only when the LVM configuration is complete (before `init level 1`). The volume groups are activated by Secure Path's `init script` at `init level 2`.

- Concurrent or overlapping `ioscans` can result in the first `ioscan` reporting intermediate path states of the second `ioscan`. The second `ioscan` correctly reports the state of the paths. An application doing `ioscan` compares could erroneously detect an error when another `ioscan` begins.

- During an `ioscan`, `sdisk` drivers attach to `swsp` interface drivers instead of `fcparray` (SCSI-3) or `fcpdev` (SCSI-2). Be careful with applications that use `ioscan` output that depends on the hardware tree that existed before installation of Secure Path.

- When a path to a device managed by LVM becomes unavailable because of a controller, path link, switch, or HBA failure, you can delay the I/O requests by up to one minute immediately after the failure. As a result, the responsiveness of mirrored logical volumes may be affected briefly.

  When a physical volume becomes unavailable, applications generally experience a delay while an I/O request to that physical volume times out. By default, this delay is 30 seconds, but you can change the delay time using the `pvchange(1M)` command.

  - If you issue a read command, LVM selects another mirror and tries again.
  - If you issue a write command, LVM records the error and continues, as long as the data has been written successfully to at least one mirror.

  In either case, with Secure Path installed, this initial timeout can take up to one minute. LVM keeps track of the physical volume status as Unavailable and future I/O requests do not experience this delay.

NOTE:

Before deactivating the volume group, ensure that all logical volumes of the volume group are unmounted. See "Secure Path device path representation and usage" for details.

Secure Path Manager (spmgr)

The following problems may arise in `spmgr` for Active-Passive disk arrays:

- If there are several Secure Path devices configured on the system, the Secure Path startup services can take longer because device scanning is initiated to synchronize Secure Path persistence data.
- If a preferred path to a device is in the Failed state, and you run a `spmgr restore -d device` command, the command line displays the prompt only. The path remains in a Failed state and no path change is made. This is the expected response to the command.
- The `spmgr alias` command is used to refer to a large cumbersome old name using a shorter or clearer alias. Reversing the argument order in `spmgr alias` *alias_name old_name* results in the alias replacing the old name. Any command using the old name results in an error. You must delete the alias for the old name to work correctly.
- The `spmgr alias` command checks a table of reserved words to prevent you from using words in an an alias that would result in unexpected behavior. However, this list is not comprehensive. Be careful to avoid using special characters that could be misinterpreted by the shell, such as a leading "-" or "$." The current list of reserved words maintained by `spmgr` are:

  ```
  add alias client delete display help log notify on off password
  prefer quiesce restart restore select set spmgr unalias unprefer
  ```

- The `spmgr restore -r 0000-0000-0000-0000` command should produce an error for an invalid WWNN, but instead it successfully restores all preferred paths on all attached arrays just like the `spmgr restore all` command.
- If you enable auto-restore using the `spmgr set -a on` command, and then select a new path using the `spmgr select -p path_instance` command, the path remains selected and will not be auto-restored. Auto-restore returns to the currently active path only if that path has failed and has been repaired.
- The `spmgr add` *any_arg any_arg WWLUNID* command generates the following error message:

  ```
  Lun should be 0-7
  ```

  The error message should read:

  ```
  Unable to locate an unclaimed unit with that World Wide LUN ID.
  ```

- The `spmgr display -d device` command requires a device *(c#t#d#)* as an argument, but accepts a `WWLUNID` as the argument and responds with missing or incorrect data. Use only *device* with the `-d` option.
- The `spmgr select` and `spmgr restart` commands occasionally respond with the following error message:

  ```
  Error:  Invalid Argument
  ```

  The command completes successfully. If you see this error, verify command success using the `spmgr display` command.
- Notification event messages that contain fields for the adapter instance *(td#)*, array `WWNN`, or `LUN WWLUNID` sometimes report either `DON'T CARE` or * as the identifier. This reporting error has no impact on Secure Path operation, and specific failure or change parameters can be viewed with the `spmgr display` command.
- Using `spmgr set -p on|off` *WWNN,* `spmgr set -a on|off` *WWNN,* or `spmgr set -b on|off` *WWNN* without the on|off argument, or using `spmgr set -f` *interval* without the *interval* argument always returns that parameter to the installation default values. Omitting the `on|off` argument returns path verification to `on`, auto-restore to `off`, load balancing to `off`, and the verification interval to 30 seconds.

Interoperability with Ignite-UX software

Ignite-UX software does not support Secure Path 3.0F SP2 for the following reasons:

- When Secure Path 3.0F SP2 is installed on a system, the hardware addresses of all EVA disk LUNs change. During the recovery process, importing LVM volume groups on the EVA array may fail.
- If the boot disk resides on an EVA array, the system fails to boot due to an LVM configuration failure.
- Secure Path 3.0F SP2 is not included in the installation kernel and is not part of the core HP-UX operating system.

Secure Path 3.0F SP2 for Active-Active disk arrays

This section describes the following:

- Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Active disk arrays
- Operating system support
- Avoiding problem situations

Differences between Secure Path 3.0F SP1 and 3.0F SP2 for Active-Active disk arrays

This section describes the following:

- Issues resolved in Secure Path 3.0F SP2
- Changes made in this release

Issues resolved in Secure Path 3.0F SP2

The following issues have been resolved in Secure Path 3.0F SP2 for Active-Active disk arrays:

- In Secure Path 3.0F SP1 with the XP storage system, if I/O was sent to a LUN (with the load balancing policy set to RR or PP) after a partial LUN collision, it resulted in system panic.
- The timeout issue with 4 GB QLogic HBAs (AB378A, AB379A) has been resolved.

Changes made in this release

The following features are supported in this version of Secure Path for Active-Active disk arrays:

- A check has been introduced to wait for the I/O to complete on the path on which I/O is originally issued, before final closing of the device.
- The autopath driver can now reroute VxVM based I/O's. The I/O is returned to VxVM only on an `All Paths Failed` condition.
- Support is available for Virtual Device Special File (referred to as "vdsf" in this document) for each LUN under Secure Path's control for high-availability access.
- A new `autopath virtualdsf` command is available to create the virtual device files for all LUNs under Secure Path's control.
- A new `autopath virtualdsf clean` command is available to release the virtual device files for LUNs deleted from Secure Path's control.
- Proactive path monitoring detects the failed path ahead of time for faster I/O failover. A new `autopath monitor` command is available to start the monitor deamon and control the failback, and trigger proactive path monitoring.
- Support for high-availability dump on HP-UX 11i v2.0. You must install the HP-UX patch bundle `DumpAASupport` to enable the dump feature.

NOTE:

To configure the high-availability dump device, you must not use a device path that has failed even if it the device has alternate active path.

If the dump patch is not installed and the `autopath discover` command is run, warning messages are displayed in the syslog.

- Read optimization is available for EVA Active-Active arrays to increase I/O performance.

NOTE:

If read optimization is enabled, load balancing is applied only on optimum paths, not on all paths configured to the end LUN.

- You can add or delete arrays using the array WWN for EVA arrays and the array ID for XP arrays.
- The `autopath display` command for XP arrays now displays the array IDs in decimal notation instead of hexadecimal notation.

Operating system support

Table 7 lists the system features and requirements for Secure Path 3.0F SP2 for Active-Active disk arrays. For additional support information, go to the HP web site http://www.hp.com/support.

Table 5 Secure Path 3.0F SP2 for Active-Active disk arrays system features and requirements

System feature	Requirement
HP-UX version	HP-UX 11i v1.0 (64–bit) HP-UX 11i v2.0
HP-UX server system types	A-class: rp24xx K-class (64-bit only): Kx60, Kx70, Kx80 L-class: rp54xx N-class: N4000, rp74xx V-class: V2200, V2250, V2500, V2600 rp7410, rp8400 rx1600, rx2600, rx4640, rx5670, rx7650, rx8620 zx2000, zx6000 Superdome, Superdome Integrity
File systems	HFS (UFS) JFS (VxFS)
Fibre Channel host bus adapters (HBAs)	HP A6826A HP A9782A HP A9784A HP A5158A HP A6795A HP A6685A (K-class server only) HP AB378A HP AB379A
Volume managers	HP Logical Volume Manager (LVM) or Veritas Volume Manager (VxVM)
Clustering	HP MC/ServiceGuard A11.15 or later
Fibre Channel mode	Switched Fabric and Arbitrated Loop

Table 8 lists the supported devices and driver requirements for this release and earlier releases of Secure Path 3.0F SP2 for Active-Active disk arrays.

Table 6 Secure Path 3.0F SP2 for Active-Active disk arrays supported devices and driver requirements

HP-UX version	Supported HBAs	Driver version (minimum)	Supported storage arrays
11i v1.0	A5158A A6685A A6795A	Fibre Channel B.11.11.01	EVA3000 (HSV101) EVA4000 EVA5000 (HSV111) EVA6000 EVA8000 XP48 XP128 XP256 XP512 XP1024 XP10000 XP12000
11i v1.0	A6685A A6826A A9782A A9784A AB378A AB379A	Fibre Channel B.11.11.07.01	
11i v2.0	A6795A A6826A A9782A A9784A AB378A AB379A	Fibre Channel B.11.23.04.01	

NOTE:

All listed storage arrays are supported for each HP-UX version.

Table 9 lists the patch revisions for this release and earlier releases of Secure Path 3.0F SP2 for Active-Active disk arrays.

Table 7 Patch revisions for Secure Path 3.0F SP2 Active-Active disk arrays

HP-UX version	Patch revisions (minimum)
11i v1.0	Hardware Enablement Bundle June 2004 HWEnable11iB.11.11.0406.5 or later ULM-SERVICE B.11.11.01 SCSI Upper Layer Module Service PHKL_27321 Early KRS PHKL_27096 PHKL_32670 1.0 SCSI Upper Layer Module Service Patch PHKL_34161 1.0 Fibre Channel Mass Storage Patch
11i v2.0	Hardware Enablement Bundle May 2005 HWEnable11iB.11.23.0505 or later DumpAASupport (to enable HA support for Active-Active disk array dump devices)

Table 8 lists the configuration limits for Secure Path 3.0F SP2 Active-Active disk arrays.

Table 8 Configuration limits for Secure Path 3.0F SP2 Active-Active disk arrays

Parameter	Minimum	Maximum qualified	Maximum supported
Adapter support	1	4	Platform limit
Storage arrays per host	1	4	Platform limit
LUNs per storage array per host	1	Array limit	Array limit
Paths per LUNs	1	32	N/A

Avoiding problem situations

The following problems may arise during Secure Path operations:

- The status of a path is updated only when I/O occurs on that path or when proactive path monitoring is enabled.
- Only Fibre Channel connectivity is supported.
- When all paths to an end LUN fail in the case of I/O to non-LVM devices with the HFS file system, or asynchronous I/O to non-LVM devices, I/O to the LUN waits until connectivity through these paths are restored. I/O starts only if the original path (the path on which I/O was started) is restored.
- Secure Path does not recognize newly added paths or devices that are in use before running the `autopath discover` command.
- Devices are not discovered automatically on installation and after reboot, if `autopath discover` is set to `off`.
- Discovery of new paths or LUNs occurs only if `ioscan` and `insf -e` are run before running the `autopath discover` command.
- If `ioscan` and `insf -e` are not run before running the `autopath discover` command, and if changes are made in the SAN, `autopath discover` may take a long time to complete because of attempted retries by the lower-level layers on the device paths.
- The Secure Path command line utility (`autopath`) does not support wildcard characters. For example, you cannot use the question mark (?) with a command to invoke the `help` command.
- If `HPswsp` is marked for removal using `swremove`, and if the remove process is aborted, the load balancing policy setting is reset to `NLB` (the default).
- In a LUN collision, the new LUN is discovered through paths used by the old LUN, provided the old LUN is not mounted or open. If the old LUN is mounted or open, the paths to the old LUN are marked as failed because the LUN is unpresented. To recover the old LUN, assign the same SCSI LUN ID to the old LUN. To access the new LUN, present it at a different SCSI LUN ID, or unmount or close the old LUN and run the `autopath discover` command.

NOTE:

- Secure Path 3.0F SP2 for Active-Active disk arrays supports `Infinite Retry` for VxFS file systems only.
- If a device configured under the HFS file system encounters an `All Paths Fail` condition, I/O restarts only if the path on which it was started is active.
- If the file system changes from VxFS to HFS, Secure Path 3.0F SP2 for Active-Active disk arrays does not automatically set the timeout value for a LUN as `Infinite Retry`.

> **IMPORTANT:**
> For information about Secure Path device path representation and usage, see "Secure Path device path representation and usage".

Secure Path device path representation and usage

This section provides information about device path representation, usage, and HP recommendations for Secure Path devices:

- Device path representation of Secure Path for Active-Active disk arrays
- Differences between Secure Path for Active-Active disk arrays and LVM PVLINKS
- HP recommendations

Device path representation of Secure Path for Active-Active disk arrays

Secure Path for Active-Active disk arrays uses the physical paths to an end device. HP-UX sees the alternate paths as actual device files. You can view and access these paths.

Example:

```
# autopath display
 =================================================================
 HPswsp Version         : A.3.0F.02F.00F
 =================================================================
 Auto Discover          : OFF
 =================================================================
 Array Type             : EVA-AA
 Array WWN              : 5000-1FE1-0015-3530
 Read Optimize          : ON
 Path Verification Period : 00:10
 =================================================================
 Lun WWN                : 6005-08B4-0010-735A-0000-5000-0082-0000
 Virtual Device File    : /hpap/dsk/hpap0
 Load Balancing Policy  : No Load Balancing
 Lun Timeout            : Infinite Retry (-1)
 =================================================================
 Device Path                   Status
 =================================================================
 /dev/dsk/c10t0d1              Active
 /dev/dsk/c12t0d1              Active
 /dev/dsk/c14t0d1              Active
 /dev/dsk/c16t0d1              Active

 =================================================================
```

Differences between Secure Path for Active-Active disk arrays and LVM PVLINKS

This section provides information about Secure Path for Active-Active disk arrays with LVM and LVM PVLINKS:

- Secure Path for Active-Active disk arrays with LVM
- Secure Path for Active-Active disk arrays with LVM PVLINKS

Secure Path for Active-Active disk arrays with LVM

For a device configured under LVM, if the LVM primary path fails, then Secure Path fails over to an alternate path and continues processing the I/O until the primary path is restored. When the primary path is restored, I/O resumes on the LVM primary path.

Secure Path for Active-Active disk arrays with LVM PVLINKS

Secure Path takes control of the device configured under LVM with PVLINKS for alternate paths, and overrides LVM PVLINKS to provide automatic I/O path failover and failback functionality. LVM PVLINKS provides an alternate path for the device during system reboot.

HP recommendations

HP recommends that you specify the physical volume paths while configuring LVM with PVLINKS and using LVM PVLINKS with Secure Path for Active-Active disk arrays. The alternate physical paths are a combination of paths that emerge from different HBAs, pass through different switches, and map to different controller ports on the disk array.

In this configuration:

- Secure Path provides high availability and load balancing to the volume group when the system is up and running.
- LVM PVLINKS provides high availability if the LVM primary path fails during system boot.

The following example shows the list of devices managed by Secure Path:

```
# autopath discover


# autopath display
 ================================================================
 HPswsp Version          : A.3.0F.02F.00F
================================================================
 Auto Discover           : OFF
================================================================
 Array Type              : EVA-AA
 Array WWN               : 5000-1FE1-0015-3530
 Read Optimize           : ON
 Path Verification Period : 00:10
================================================================
 Lun WWN                 : 6005-08B4-0010-735A-0000-5000-0082-0000
 Virtual Device File     : /hpap/dsk/hpap0
 Load Balancing Policy : No Load Balancing
 Lun Timeout             : Infinite Retry (-1)
================================================================
 Device Path                     Status
================================================================
 /dev/dsk/c10t0d1                Active
 /dev/dsk/c12t0d1                Active
 /dev/dsk/c14t0d1                Active
 /dev/dsk/c16t0d1                Active


================================================================
```

The following example shows how to set the load balancing policy for all devices managed by Secure Path:

```
# autopath set_lbpolicy < {policy name} {path} >

Policy name: The load balancing policy to set. Valid policies are
     RR      : Round Robin.
     SST     : Shortest Service Time.
     SQL     : Shortest Queue Length.
     NLB/OFF : No load balancing.

  Path: Device Special File e.g./dev/dsk/c#t#d#

  Example: autopath set_lbpolicy RR /dev/dsk/c30t0d1
```

The following example shows how to configure PVLINKS using the `vgextend` command:

```
   vgextend - extend an LVM volume group by adding physical volumes
 SYNOPSIS
     /usr/sbin/vgextend [-f] [-A autobackup] [-g pvg_name]
          [-x extensibility] [-z sparepv] vg_name pv_path ...
```

The following example shows how to add the physical volumes `/dev/dsk/c0t1d0` and `/dev/dsk/c0t2d0` to the volume group `/dev/vg03`:

```
# vgextend /dev/vg03 /dev/dsk/c0t1d0 /dev/dsk/c0t2d0
```

NOTE:

You can use the `autopath display` command to determine the alternate paths: `/dev/dsk/c0t1d0` and `/dev/dsk/c0t2d0` for `vg03`.